Using the Technology Acceptance Model to determine Teachers' Attitudes towards the introduction of iPads in the Classroom

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Pamela Cowan and Jenna Earls
School of Education
Queen's University Belfast
United Kingdom
p.cowan@qub.ac.uk

Abstract: This paper reports the findings of a case study conducted in a high school. The Technology Acceptance Model was adapted to address iPads as the new technology for teaching staff. The survey was administered online to 48 teachers ranging from senior management in the school to classroom teachers. Findings indicate that no significant difference was found in attitudes by age or seniority of role in the school across the main constructs of Perceived Ease of Use (PEU), Perceived Usefulness (PU) or Intention to Use. However gender differences did exist for PEU in time point 1 and PU in time point 2. Sub-scales however were revealed for PEU and PU. Image was found have no bearing on the teachers' iPad usage behavior. Correlations between the constructs changed over the course of the academic year as iPads became more embedded in teachers' pedagogical practice. Educators need to be aware of the role of leadership and management, effective pedagogy, training and support, and the ICT infrastructure, as key elements in the successful adoption of iPads across a whole school.

Introduction

The integration of new technologies into the classroom has been the subject of on-going research for many decades (Cox, 1997, Cuban, 2001, Cowan *et al*., 2011). With the advent of widespread wireless connectivity across the campus, the use of handheld devices has become widespread in schools today. In addition, through the acceptance of Bring Your Own Device (BYOD), many school leaders are facing the dilemma of both android and Apple iOS becoming prevalent in their classroom. In the interests of data security, digital safeguarding and e-safety, many school leaders are deciding to align the student experience by issuing all teaching staff with a school-owned iPad complete with apps to support teaching and learning, administration and record-keeping. Melhuish and Falloon (2010) note five affordances or pedagogical benefits associated with the use of iPads in teaching, namely

- portability encouraging 3rd Place learning,
- affordable and ubiquitous access offering greater equity and inclusion,
- situatedness enabling constructivist learning in authentic contexts,
- connection and convergence to facilitate opportunities to create, share and connect with others outside the classroom,
- individualized and personalized experiences offering learning tailored to individuals needs and preferences.

Professional development for teachers in the use of these handheld devices, especially iPads, is key to their acceptance and integration into classroom pedagogy. Modern classrooms are active and engaging learning spaces designed to "*motivate learners and promote learning as an activity, support collaborative as well as formal practice, provide a personalized and inclusive environment, and be flexible in the face of changing needs*" (JISC, 2006, p. 3). Fusch (2011) identified the ease of use, mobility and vast array of apps as features of the iPad which make it ideal for classroom use. However compared to a desktop computer or laptop, an iPad lacks memory for storage, USB port for sharing, and requires a secure and reliable internet connection to access cloud-based resources and applications. Despite its simple touch-screen interface and limited menu options,

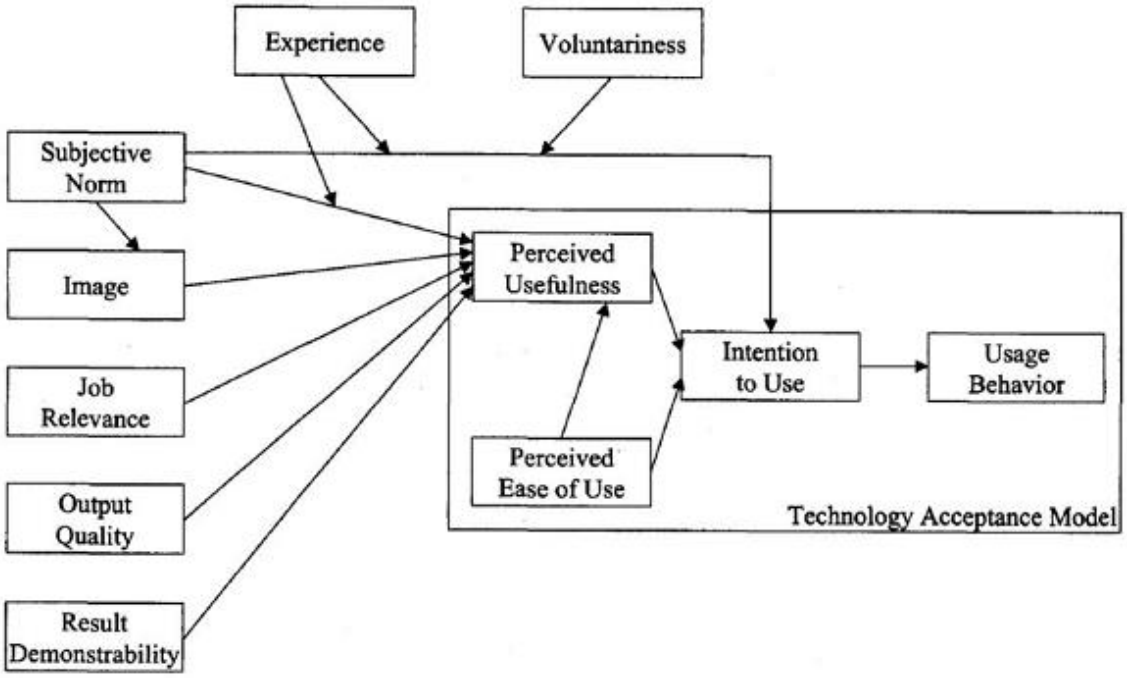
teachers need time to adapt to the new technology, to become confident navigators between apps and to re-visit their teaching approaches to maximize the affordances of this new technology. Consequently a focus is needed on a pedagogical agenda which highlights the most effective ways in which the iPad technology can be harnessed to support or even transform the student learning experience (Burden, 2012). But first it is important to identify what makes a new technology, such as iPads, become accepted by teachers and are there specific attitudes and aptitudes which are peculiar to some teachers more so than others?

This question is the focus of this study. If iPads are to be embedded in teaching and learning across a whole school, what facilitates the acceptance of the technology? Does teaching experience, gender or age impact on the teachers' attitude towards the new technology? To what extent does school leadership and the expectations of management influence teachers' willingness and readiness to adopt the new technology?

To address these questions the Technology Acceptance Model (TAM) first introduced by Davis (1986) to determine how users accept a new computer system was considered. The model suggests that when new users are presented with a new technology, its usage or adoption can be predicted by three factors: the Perceived Usefulness (PU) of the technology to the user, the Perceived Ease of Use (PEU) of the technology, and the Attitudes Towards Usage (ATU) of the system (Davis, 1986). If the user does not perceive the technology to be easy to use or '*free from effort*', then they are unlikely to deem it useful in terms of enhancing their job performance. The perceived usefulness and perceived ease of use of the technology impact directly on the user's intention to use (or not use) the system (as noted in the boxed part of Figure 1 below).

Fishbein and Ajzen's (1991) Theory of Reasoned Action (TRA) claim that an individual's attitude toward carrying out a behavior and an evaluation of the value of the outcomes of the behavior influence social behavior. In the case of using a new technology, the intention to use (IU) he technology determines the usage behavior as denoted by the right-hand side of Figure 1.

By 2000, Venkatesh and Davis had developed the model to include the social influences such as subjective norm (mandatory use requiring compliance), Image (or enhancing one's status in a social system), voluntariness (perceived option to accept or reject the technology) and the cognitive instrumental processes such as job relevance, output quality and result demonstrability. (See Figure 1 – left hand side)



Source: Venkatesh, V. and Davis, F. D. (2000). *Management Science*, 46 (2), 186-204.

The Study

All teachers in the case study high school were invited to participate in the study. The TAM questionnaire was adapted to include iPads as the new 'system' and three additional items addressing creative classrooms were appended to the model. The adapted TAM questionnaire, with 5-point Likert scale, was administered online via Google Forms at two time points in the academic year, in the first and third school term. Paper copies of the questionnaire were also available should the respondents prefer this option. Section 1 of the questionnaire collected the biographical data such as gender, age, years of teaching experience, professional role, subject(s) taught. Section 2 was the adapted TAM plus any additional comments from the respondent. The questionnaire was piloted with a small number of teachers from a neighboring high school to check for ambiguity. There was a 80% response rate to each of the two questionnaires from the case study school. ID codes were used to match respondents in the two timeframes.

The data from the online questionnaire was imported into SPSS for analysis. Descriptive statistics were generated from Section 1 offering an overview of the profile of respondents in terms of their current roles as teachers or senior teaching staff in the school. Exploratory Factor Analysis was completed on Section 2 to establish if the TAM constructs held for the case study school. This process was completed for both time points in the study. Some sub-factors emerged from the data and will be reported in the next section. As a result, profile analysis was used to compare the PEU, PU and IU by gender, age, and job role. Cronbach's alpha was calculated in all cases. The results are reported in the next section. The correlations between the constructs and the sub-factors were also calculated for each time period to illustrate the change in attitude over the academic year as the iPad technology became embedded in the pedagogy of the classroom.

Findings

The sample consisted of the 36 participants in total, of whom 15 (41.7%) participants were male and 21 (58.3%) participants were female which is reflective of the gender distribution in the teaching staff in the high school. Of the respondents, 36.1% were 31-39 years old, 36.1% were40-49 years old, 19.4% of respondents were in the 22-30 years old category and 8.3% were 50-59 years old. The professional role (Job) of teachers in the sample consisted of 44% classroom teachers, 41.6% Heads of Department, 13.9% were Senior Leaders and 2.7% are Heads of Year. The majority (94%) of the participants had received internal training on the use of the iPads by digital mentors ('innovators') within the school by the first time point for the questionnaire.

Exploratory factor analysis was used to confirm the factor structure for the adapted TAM. Each factor was considered in turn, PEU, PU, IU and so on, and the reliability of the factor calculated using Cronbach's alpha. A 4-factor sub-structure emerged for Perceived Ease of Use (PEU) which accounted for 73.85% of variance is shown in Table 1.

Sub-factor	**No. of items.**	**Cronbach's alpha**
Personal ease of interaction with the iPad	8	0.909
Cognitive ease of use when using the iPad	4	0.832
Personal intention of using the iPad	2	0.977
Personal confidence when using the iPad	2	0.408

Table 1 Sub-factors of PEU

A 2-factor sub-structure emerged for Intention to Use (IU) which accounted for 69.95% of variance.

Sub-factor	**No. of items.**	**Cronbach's alpha**
Effectiveness when using the iPad	7	0.936
Time management	7	0.900

Table 2 Sub-factors of IU

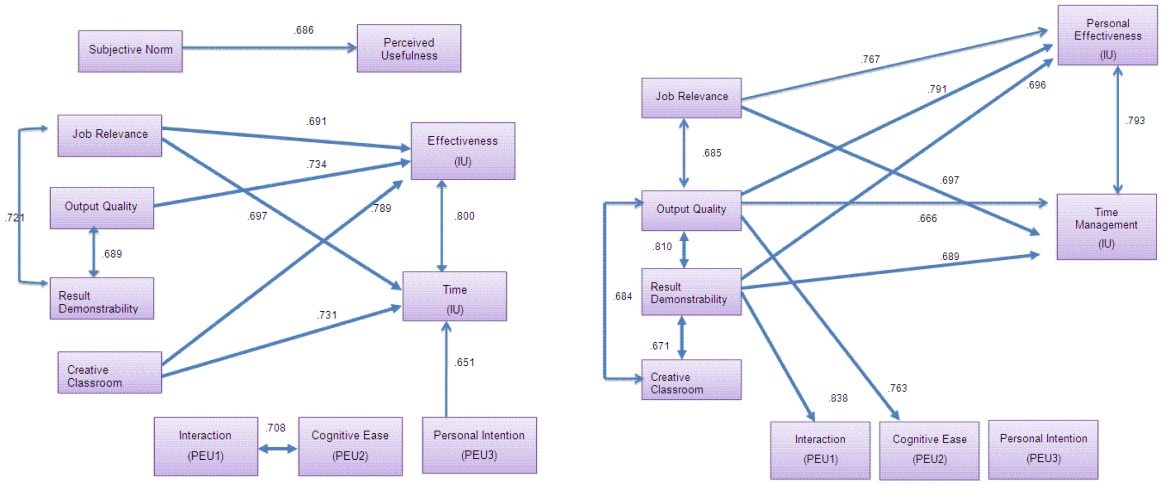
The remaining TAM factors with their reliabilities are reported in Table 3.

TAM factor	No. of items.	Cronbach's alpha
Subjective Norm	2	0.939
Voluntariness	3	0.706
Image	3	0.794
Job Relevance	3	0.788
Output quality	2	0.763
Result Demonstrability	4	0.672
Creative classrooms	3	0.879

Table 3 TAM factors.

Pearson Correlations were calculated to determine the presence of strong associations between these factors and the extent to which this extended model replicated the original TAM. Figure 2 shows all correlations over 0.65 at time point 1 (start of the academic year) and at time point 2 (end of the academic year).

Figure 2 Time 1 Time 2



The above diagrams indicate that the subjective norm arising from the mandatory nature of the use of the iPads and therefore the compliance by teachers to use them (a behavior) has disappeared by time point 2 and as a result, perceived usefulness has also gone from the correlation model. It is also interesting to note the job relevance is correlated with output quality by time point 2 as are the creative classroom and result demonstrability factors. It would therefore appear that the previously external factors are becoming more interconnected. In addition, it is notable that the strong correlations between creative classrooms and effectiveness and time at time point 1 have disappeared by time point 2. More importantly it seems result demonstrability has transformed from impacting only on output quality (time 1) to be associated with personal effectiveness when using the iPad, time management and interaction with the iPad indicating a transformation in the tangibility of the results of using the innovation by time point 2. Output quality in time point 2 is also associated with time management and cognitive ease indicating possible assimilation of the iPads by the teachers.

The correlation models in Figure 2 reflect the transition from top-down mandate to use iPads which was imposed on teachers by the senior management team to the more teacher-centred, pedagogically-driven use of iPads with clear links to outcomes valued by teachers.

This section investigates the presence of significant differences in the use or acceptance of iPads by the teachers. Profile analysis was completed on the mean scores of the factors (and sub-factors) of PEU, PU and IU as the main factors impacting on Usage Behavior. No significant differences emerged by gender, age or job as shown in Table 4 apart from PEU by gender (time 1) which revealed that the male teachers perceived the iPads to be easier to use more so than the female teachers at time point 1; and PU by gender (time 2) which revealed that males perceived the usefulness of iPads to be higher than females at time point 2.

Comparison	**Time point 1**		**Time point 2**	
	F value	**p-value**	**F value**	**p-value**
Perceived Ease of Use (PEU)				
By gender	F(34, 1) = 4.21	**p=0.048**	F(34,1) = 2.32	p=0.137
By age	F(32, 3) = 0.40	p=0.751	F(32,3) = 0.30	p=0.823
By job category	F(32, 3) = 0.54	p=0.735	F(31,3) = 2.07	p=0.125
Perceived Usefulness (PU)				
By gender	F(32, 1) = 2.09	p=0.158	F(33,1) = 5.71	**p= 0.023**
By age	F(30, 3) = 0.81	p=0.498	F(31,3) = 0.43	p=0.732
By job category	F(30, 3) = 0.63	p=0.602	F(31,3)= 2.07	p=0.125
Intention to Use (IU)				
By gender	F(34,1) = 1.40	p=0.245	F(34,1) = 1.26	p=0.291
By age	F(32,3) = 0.54	p=0.661	F(32,3) = 0.20	p=0.895
By job category	F(32, 3)= 0.56	p=0.644	F(32,3) = 0.63	p=0.603

Table 4 investigation of significant differences gender, age and job.

Conclusions

This case study research set out to establish if iPads are to be embedded in teaching and learning across a whole school, what facilitates the acceptance of the technology? Does teaching experience, gender or age impact on the teachers' attitude towards the new technology? To what extent does school leadership and the expectations of management influence teachers' willingness and readiness to adopt the new technology?

From the findings above the TAM reveals the presence of sub-factors in PEU such as personal interaction with the iPad, cognitive ease when using the iPad and personal intention to use the iPad as elements of importance when planning training programmes to support the roll-out of this new pedagogical tool. Building on previous experiences of embedding new technologies in the classroom where only technical training was provided, it appears that the internal support by the digital mentors (innovators) has incorporated a sufficient level of pedagogical emphasis and collaboration to ensure the 'ease of use' was apparent from the outset. In addition, the IU factor had two component parts: the teacher's effectiveness when using the iPad and time management. Again these sub-factors are aligned with the existing knowledge associated with professional development in new technologies and they also map onto the pedagogical implications of using iPads.

The consistency of the message presented through the TAM suggests it is acting as a reliable measure of the factors which facilitate the acceptance of iPads into teaching. Due to the touch screen nature of iPads and their limited menus, it may be assumed that these features make them easier to 'learn' however it should be acknowledged that many teachers have become used to GUI with icons and menu bars making the lack of options disconcerting for the first time user. Indeed cloud storage rather than a folder structure on the hard drive may also pose concerns for the more sequential and organized teacher who likes to back-up his/her work regularly. By investigating the presence of age, gender or experience teaching (as measured via job role) it was possible to determine if these concerns existed in the case study school. The findings revealed little difference across the teachers apart from a more 'give it a go' attitude from the male teachers from time point 1 who found iPads slightly easier to use than the female teachers initially, and then by time point 2 this difference has gone only to be replaced by the male teachers seeing the relevance and usefulness of iPads for teaching more clearly than the female teachers.

Finally some evidence exists in the correlation models at each time point that school leadership and the expectations of management influenced teachers' willingness and readiness to adopt the new technology initially as denoted by the compliance associated with Result Demonstrability being associated with Job relevance and Output quality only. By time point 2 it was clear that the teachers had uncovered the value of the iPads themselves and were convinced of their role in teaching as shown by the correlations with the factors, personal effectiveness, time management and interaction with the iPads. In addition the absence of the Subjective Norm from the model in time point 2 would indicate its correlations with the other factors were less than 0.65. The mandatory requirement to use the iPads had been replaced over the academic year by an understanding of and personal desire by the teachers to continue to use them to increase their effectiveness as a teacher.

It is acknowledged that this paper is reporting on one aspect of an in-depth case study and that the findings cannot be generalized beyond the individual case. Nonetheless the findings in relation to the TAM are worthy of further investigation and may be informative in demonstrating to senior management teams in schools that providing ring-fenced time for in-house training and collaboration between staff on the use of new technologies in their own school context offers authentic learning experiences for the teachers and results in a shift in culture and capability as advocated by Fullan and Langworthy (2014).

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